D. Remarks

In the above-identified Office Action, the Examiner objected to the specification (see middle of page 2 of the Office Action), for reciting a comment on page 15, line 6 of the specification. Accordingly a paragraph containing this comment has been amended as shown above in the amendment to the specification. This paragraph is also amended to correct typographical errors. Accordingly Applicants respectfully request the Examiner to withdraw the objection to the specification.

The specification is also amended at page 18, line 21 to replace the reference numeral 624 used to identify a half-wave plate with a new reference numeral 623, because the reference numeral 624 was also used (by mistake) for another item, namely an amplifier as shown on originally-filed page 19, line 9. The just-described change in reference numerals (from 624 to 623 for the half wave plate) is also made by amendment to FIG. 22 in the drawings. In anticipation of the Examiner's approval of the just-described drawing amendment, formal drawings incorporating this change are being concurrently submitted herewith in a separate paper addressed to the Official Draftsperson. As shown in the attached Exhibit A which is a copy of a return receipt postcard, these formal drawings were previously submitted on June 6, 2001 but are being re-submitted in view of a PTO-948 included in paper no. 13 as a part of the Office Action.

Claim 17 was indicated as being allowable if rewritten in independent form at page 5 of the above-identified Office Action. Accordingly Claim 17 has been rewritten. Therefore, Claim 17 is in form for allowance. New Claims 38-47 depend from Claim 17 and are therefore also patentable for at least the same reasons as Claim 17. Support for Claims 38-48 is found in, for example, originally-filed Claims 2-15.

Claim 1 was rejected as being anticipated by U.S. Patent 6,489,624 granted to Ushio et al. In rejecting Claim 1, the Examiner stated "Ushio et al. disclose illuminating the wafer (60) with a beam of electromagnetic radiation having a majority of energy polarized in a direction other than parallel to a longitudinal direction of the feature; and measuring intensity of a portion of the beam reflected by the wafer (Col. 22, lines 37-42);" See the above-identified Office Action in the top half of page 3, at lines 3-6. Applicants respectfully traverse the Examiner's statement. Specifically, there is no suggestion whatsoever in Ushio's column 22,

SILICON VALLEY
PATENT GROUP LLP
2350 Mission College Blvd.
Suite 360
Santa Clara, CA 95054
(408) 982-8200
FAX (408) 982-8210

lines 37-42 that polarized light is to be used. The following is an exact quote of Ushio's column 22, lines 37-42:

> Probe light was directed to impinge upon the wafer 60 from above (i.e., on the layer 64) at an angle of incidence using an optical system as shown in FIG. 7. The luminous intensity of probe light reflected (as signal light) from the surface of the wafer 60 (wafer denoted as item 47 in FIG. 7) was detected and measured using a detector.

The word "polarized" is not found in the above quote. The above quote appears to be the sole basis for the Examiner's rejection of Claim 1.

Claim 1 is amended to clarify that the majority of energy is polarized in a direction, and that said direction is other than parallel to a longitudinal direction of the feature. Applicants submit that this amendment is merely a clarification of a limitation that was already inherent in originally-filed Claim 1. For this reason Applicants submit that there has been no change in scope of Claim 1 due to the amendment. If the Examiner disagrees about the effect of the amendment to Claim 1, Applicants respectfully request the Examiner to state in the next Office Action the reasons why the Examiner believes the scope of Claim 1 has been changed. The same kind of change is also made to Claims 29 and 36, and Applicants submit that the scope of these claims also remains unchanged even after amendment. Again, if the Examiner believes otherwise, she is invited to state on the record her reason(s) for such belief.

Applicants respectfully bring to the Examiner's attention the following description in Ushio's column 3, lines 36-59 wherein use of a polarized light is mentioned:

> Another conventional technique for measuring layer thickness is ellipsometry as disclosed in Japanese Laid-Open Patent Document No. Hei 7-193033. This technique is diagrammed in FIG. 3. A light flux emitted from an optical-fiber light source 115 passes through a collimator lens 120. The collimated light passes through a polarizer 121 that transmits the linearly polarized light component. The linearly polarized light then passes through a quarter-wave plate 122 and is converted into elliptically polarized

SILICON VALLEY
PATENT GROUP LLP

2350 Mission College Blvd.
Suite 360
Santa Clara, CA 95054
(408) 982-8200
FAX (408) 982-8210

> light. The elliptically polarized light passes through a half-wave plate 123 that changes the orientation of the elliptical axis. The elliptically polarized light is incident on the patterned surface 116 of a wafer 117, is reflected from the surface 116, and passes through a filter 124 that transmits linearly polarized light. The linearly polarized light passesthrough a condenser lens 125 to a detector 126. The polarized state of the light flux reflected from the patterned surface 116 changes depending upon the thickness of the patterned surface 116 and the polarization state of the incident elliptically polarized light. The output of the detector 126 comprises data, obtained while rotating the half-wave plate 123, that can be processed to determine the thickness of the patterned surface 116.

Applicants submit that the above-quoted text fails to disclose or suggest any orientation of a direction of polarization relative to the feature. Moreover, although Ushio states in column 18, lines 5-6 that "a monochromatic light source can be used such as a laser" there is no indication that the laser generates polarized light, and furthermore there is no suggestion of any orientation of the polarization direction relative to the feature.

In contrast, Claim 1 clearly requires the direction of polarization (for a majority of energy) to be other than parallel to a longitudinal direction of the feature. Non-parallel orientation of the polarization direction has certain advantages of the type discussed in the originally-filed specification, for example, at page 7, lines 7-23 as follows:

> In one embodiment (also called "single beam embodiment"), a feature 21A which is part of groove 21 is illuminated by a beam 22 which is polarized in a direction P. In one implementation of this embodiment, direction P forms an angle θ with a longitudinal direction of feature 21A. For beam 22 to be reflected by groove 21, an electric field must be established in floor 21 C that matches the incident electric field. This induced field re-radiates, resulting in a reflected portion of beam 22. When the incident electric field is parallel to groove 21, this occurs, and groove 21 acts like the rest of layer 28, reflecting all of the incident power other than a negligible fraction (e.g. less than 10%) that may be lost at the sidewalls 21A and 21B. Hence, the component of beam 22 that is polarized parallel

SILICON VALLEY
PATENT GROUP LLP

2350 Mission College Blvd.
Suite 360
Santa Clara, CA 95054
(408) 982-8200
FAX (408) 982-8210

to groove 21 is reflected. However, when the incident electric field is perpendicular to groove 21, and when groove width W is smaller than the wavelength of beam 22, and groove 21 is too narrow to set up a matching electric field. As a result, the reflection is very small and the component of beam 22 polarized perpendicular to groove 21 transmits as heat into substrate 30, as if groove 21 did not exist.

For this reason, beam 22's polarization direction P is deliberately selected to be not parallel to feature 21A. In the example illustrated in FIG. 3, angle $\theta > 45°$. Preferably, but not necessarily, angle $\theta \cong 90°$ (e.g. within 10% which is $\pm 9°$).

Applicants also respectfully draw the Examiner's attention to an act 11 illustrated in originally-filed FIG. 2, which reads "illuminate wafer with a beam polarized not parallel to a feature to be evaluated." The above remarks are merely illustrative of an embodiment covered by Claim 1.

An orientation relationship between (a) polarization direction of energy in beam and (b) direction of a feature, as recited in Claim 1 is neither disclosed nor suggested by Ushio. Therefore, Applicants respectfully submit that Claim 1 is patentable over the teachings of Ushio. Claims 2-10 depend either directly or indirectly from Claim 1 and are therefore patentable over the teachings of Ushio for at least the same reasons as Claim 1. Applicants further submit that Claims 11-15 which depend from Claim 1, although withdrawn from consideration, are now in form for allowance (assuming Claim 1 is allowed).

Independent Claims 29 and 36 are amended in a manner identical to Claim 1, and are believed to be allowable for reasons similar to those discussed above for Claim 1. Moreover, Claims 30-35 and 37 depend from Claims 29 and 36 and are therefore patentable for at least the same reasons as Claims 29 and 36.

Applicants submit that the above-identified Office Action is replete with mis-statements about the teachings of Ushio. For example, the Examiner states in the middle of page 3 of the Office Action that Ushio teaches that "the act of measuring is performed

SILICON VALLEY
PATENT GROUP LLP

2350 Mission College Blvd.
Suite 360
Santa Clara, CA 95054
(408) 982-8200
FAX (408) 982-8210

repeatedly at a plurality of locations transverse to the longitudinal direction of the groove (Col. 22, lines 42-47)." The text in Ushio's Col. 22, lines 42-47 is reproduced below:

> During measurements, the detector was moved by the goniometer 46, simultaneously with changing the impingement location of the probe light on the wafer 60 so that the signal light reflected from the surface of the wafer 60 could continue to be detected.

The above-quoted text merely states that Ushio's detector is moved. The above-quoted text does not identify the direction of movement and its relation to the direction of the feature. Since the above-quoted text is the sole citation, the Examiner has no basis in the prior art to state that the direction of motion in Ushio is transverse to the direction of a groove. Claim 2 is therefore patentable for at least this additional reason.

Although there are a number of mis-statements by the Examiner in the above-identified Office Action about the teachings of Ushio, Applicants will now provide just one more example. Specifically, the Examiner states in the bottom half of page 3 of the Office Action that Ushio teaches "forming a feature of conductive material (63) in a wafer (60) by using at least one process parameter; and changing the process parameter depending on measurements obtained from the act of repeatedly measuring (Col. 22, lines 42-64)." The text in Ushio's Col. 22, lines 42-47 was reproduced above, and the remaining text (Col. 22, lines 48-64) is reproduced below:

> As the angle of incidence of the probe light was changed (using the goniometer 46) , the spectrum of probe light exhibited various changes. For example, whenever the incidence angle was small (<35°), the obtained spectrum of the signal light was complex and significantly different from the spectrum obtained from a planar layered film. However, whenever the incidence angle was 35° or more, less signal light was detected, but the spectrum of the signal light was the same as that obtained from a planar structure comprising a Si substrate, an SiO_2 "heat oxide" layer (573 nm), an aluminum layer (700 nm), and an SiO_2 layer (390 nm) That is, by directing the probe light to impinge upon the wafer 60 at a substantial angle, the spectrum of signal light obtained when the probe light reflected from a region

SILICON VALLEY
PATENT GROUP LLP
2350 Mission College Blvd.
Suite 360
Santa Clara, CA 95054
(408) 982-8200
FAX (408) 982-8210

> of the wafer lacking surficial irregularities was observed to have the same spectrum as probe light reflected from a region of the wafer having such surficial irregularities.

The above-quoted text merely states that Ushio is performing a measurement. The above-quoted text does not indicate that by using Ushio's measurement, a process parameter for forming a conductive layer is to be changed. Claim 16 is therefore patentable for at least this additional reason.

Finally, Applicants respectfully traverse the Examiner's modification of Ushio's teachings with the teachings of McCoy in US Patent 5,741,614 (see page 4 of the Office Action). Applicants submit that a skilled artisan when using the measurements of Ushio will not look to McCoy at least because McCoy is from an unrelated art. Specifically, Ushio discloses an optical measurement system whereas McCoy describes using an Atomic Force Microscope probe tip to make measurements for dense photoresist patterns.

To make the combination, the Examiner's motivation was simply "to perform the measurements of the sidewalls." Following the Examiner's motivation would result in Ushio's teachings to be combined with any reference to measure sidewalls, regardless of the technology used by the reference. Such a motivation appears to be impermissibly broad, and therefore the modification of Ushio's teachings with McCoy's teachings is improper. Moreover, Applicants submit that McCoy fails to disclose or suggest any comparison. Instead, at most McCoy teaches combining measurements to form an image of the particular feature (at col. 8, lines 20-24 cited by the Examiner). The undersigned carefully reviewed the Examiner's citations in McCoy's teachings, namely Col. 7, lines 19-37, Col. 8, lines 6-7 and Col. 8 lines 20-24 and was unable to find any suggestion whatsoever for comparison of measurements. If the Examiner uses McCoy in a future Office Action, Applicants respectfully request the Examiner to identify where in McCoy there is a teaching of **comparison** of two measurements. This further supports the patentability of Claim 10.

Also, Applicants submit that there is substantial difference between measuring thickness of metal coatings on sidewalls of grooves etched into an insulator and measuring properties of photoresist sidewalls. It is unlikely that one would draw any connection between the two kinds of measurings, because one relates to a thickness measurement and the

SILICON VALLEY
PATENT GROUP LLP

2350 Mission College Blvd.
Suite 360
Santa Clara, CA 95054
(408) 982-8200
FAX (408) 982-8210

other does not, and photoresist sidewall shape relates to lithography patterning and metal coating thickness relates to metal deposition processes. In view of the above remarks, Applicants respectfully request the Examiner to withdraw the §103 rejection of Claim 10.

New Claim 48 is supported throughout the originally-filed application, including, for example, page 7 at lines 7-10, page 7 at lines 19-20 and page 7 at lines 21-23. New Claim 48 is believed to be patentable for at least the same reasons as Claim 1.

New Claim 49 is supported at, for example, page 4, line 9, page 6, line 9, and the dimension labeled as "t" in Applicants' originally-filed FIG. 4. In the next Office Action, Applicants respectfully request the Examiner to not analogize evaluating the thickness of a sidewall to evaluating the thickness of a layer (as noted above the sidewall thickness is illustrated by "t" in Applicants' originally-filed FIG. 4 whereas layer thickness is shown as "T" in FIG. 4). The just-described sidewall thickness "t" is measured along a planar surface of the wafer, whereas the layer thickness "T" is measured perpendicular to such a planar surface.

New Claims 50-52 are supported throughout the application, including, for example, page 30, lines 10-16.

For the above reasons, Applicants respectfully request allowance of all pending claims. Should the Examiner have any questions concerning this response, the Examiner is invited to call the undersigned at (408) 982-8200, ext. 3.

Via Express Mail Label No.
ER 205 699 956 US

Respectfully submitted,

S. Omkar

Omkar K. Suryadevara
Attorney for Applicants
Reg. No. 36,320

SILICON VALLEY
PATENT GROUP LLP

2350 Mission College Blvd.
Suite 360
Santa Clara, CA 95054
(408) 982-8200
FAX (408) 982-8210